Indiana Department of Education
Indiana Academic Standards Course Framework

CIVIL ENGINEERING AND ARCHITECTURE

Civil Engineering and Architecture introduces students to the fundamental design and development aspects of civil engineering and architectural planning activities. Application and design principles will be used in conjunction with mathematical and scientific knowledge. Computer software programs should allow students opportunities to design, simulate, and evaluate the construction of buildings and communities. During the planning and design phases, instructional emphasis should be placed on related transportation, water resource, and environmental issues. Activities should include the preparation of cost estimates as well as a review of regulatory procedures that would affect the project design. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead the Way network and follow all training and data collection requirements.**

- DOE Code: 4820
- Recommended Grade Level: Grade 10-12
- Recommended Prerequisites: Introduction to Engineering Design, Principles of Engineering
- Credits: 1 credit per semester, maximum of 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas
- This course is aligned with postsecondary courses for Dual Credit
    - Ivy Tech
        - DESN 105 – Architectural Design I
    - Vincennes University
        - ARCH 221 - Advanced Architectural Software Applications

Dual Credit
This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

Content Standards

Domain – History in Architecture and Civil Engineering
Core Standard 1 Students evaluate historical structures to understand the evolution of design elements, structural components and material used.

Standards

CEA-1.1 Identify and describe the different architectural styles

CEA-1.2 Analyze the influence technology innovations have had on the design and construction of structures.

CEA-1.3 Analyze the impact of innovations in tools and materials on architecture and civil engineering and design.

CEA-1.4 Explain the design concept of form and function

CEA-1.5 Identify engineering achievements through history and how those innovations have changed the way structures are designed.

CEA-1.6 Compare modern structural and architectural design to historical designs.

Domain – Careers in Architecture and Civil Engineering

Core Standard 2 Students analyze the various facets of architectural and civil engineering careers to integrate into design projects.

Standards

CEA-2.1 Indentify work ethics and behaviors that are important for career success in civil and architecture engineering.

CEA-2.2 Research college/technical schools for class requirements for a civil and architectural engineering career major.

CEA-2.3 Describe connections between engineering and other disciplines to see how they work together.

CEA-2.4 Evaluate job outlook information on various civil and architecture engineering careers.

Domain – Architectural Design, Cost & Efficiency

Core Standard 3 Students assess architectural design to incorporate the use of spatial relationships, building layout, and costs into a design project.

Standards

CEA-3.1 Describe the importance of focusing on detail when executing the design Process.

CEA-3.2 Demonstrate the principles and elements of design and incorporate them in design solutions.

CEA-3.3 Apply the steps of the design process to solve a variety of architectural design problems.

CEA-3.4 Adapt and apply math skills to calculate material costs

CEA-3.5 Use cost estimation processes

CEA-3.6 Calculate heat loss of projects

CEA-3.7 Identify and describe materials used in construction of a building or residential structure.

CEA-3.8 Identify accessibility requirements and the cost impact.

CEA-3.9 Incorporation sustainable building practices into the designs

Domain – Residential Building Design

Core Standard 4 Students establish a base knowledge of residential design concepts to develop a set of construction documents.

Standards

CEA-4.1 Identify family needs that should be considered when planning a dwelling.

CEA-4.2 Apply planning rules and techniques for the sleeping, living, and service areas of a residence.

CEA-4.3 Draw a plot plan or site plan for a residence considering drainage, property improvements, utilities and dwelling footprint.

CEA-4.4 Design footings and foundations for a residential structure.

CEA-4.5 Design and draw to scale a residential floor plan using the accepted symbols and annotation and drawing techniques.

CEA-4.6 Verify home construction costs using the cost per square foot and identify cost per type of construction, affordability, and the cost of amenities.

CEA-4.7 Demonstrate layout techniques of exterior and interior elevations and detail drawings.

CEA-4.8 Select appropriate materials to be used in residential construction in accordance to geographical location, building codes, and style of dwelling.

CEA-4.9 Analyze building codes and zoning codes for use in constructing a residential structure.

CEA-4.10 Identify components of residential framing systems

CEA-4.11 Distinguish advantages and disadvantages between different residential roof designs.

CEA-4.12 Analyze structures to identify how residential/commercial structures are assembled, current construction practices, and impact on the environment.

Domain – Commercial Building Design

Core Standard 5 Students establish a base knowledge to identify commercial building materials, building codes, and design concepts to develop a set of construction documents.

Standards

CEA-5.1 Compare commercial and residential building systems

CEA-5.2 Analyze building codes and regulations used in constructing a commercial structure

CEA-5.3 Evaluate zoning regulations for the allowable use of property

CEA-5.4 Choose appropriate commercial wall systems for structures

CEA-5.5 Determine appropriate materials for structures

Domain – Structural Components and Design

Core Standard 6 Students connect through terminology and mathematics the structural components of commercial and residential design to apply loads on a structure including beams, girders, columns and footings.

Standards

CEA-6.1 Select appropriate roof beams to carry the calculated load

CEA-6.2 Analyze load conditions of supported beams

CEA-6.3 Graphically demonstrate the structural analysis of supported beams

CEA-6.4 Determine required floor loading

CEA-6.5 Identity and describe usage of commercial foundation systems

CEA-6.6 Determine loads transferred from the structure to the ground

CEA-6.7 Design appropriate structural floor framing systems

Domain – Building Systems

Core Standard 8 Students integrate building systems including fire, plumbing, HVAC, and electrical, to properly size and appropriately serve a building project while conserving natural resources.

Standards

CEA-8.1 Apply code requirements for the installation of services and utilities

CEA-8.2 Interpret HVAC construction drawings

CEA-8.3 Analyze the need for an architect to understand how electrical, plumbing, and HVAC systems are designed and constructed

CEA-8.4 Identify and describe options for the management of wastewater

CEA-8.5 Examine how the placement of utilities effect design of the structure

CEA-8.6 Assess systems to incorporate energy conservation techniques

Domain – Surveying & Hydrology

Core Standard 9 Students connect land surveying equipment components and theory to architectural and civil engineering projects to evaluate how land surveying impacts design and construction.

Standards

CEA-9.1 Analyze a site by surveying

CEA-9.2 Classify soil samples relevant to structure designs

CEA-9.3 Create a design for storm water runoff

CEA-9.4 Compare and contrast site design factors and the impacts on the environment and surrounding properties

CEA-9.5 Demonstrate site planning with consideration of codes and facility requirements

CEA-9.6 Analyze drainage patterns, vegetation, and construction materials to determine the impact of design elements and methods to modify the surrounding terrain.

Process Standards

Reading Standards for Literacy in Technical Subjects 9-10

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Key Ideas and Details

9-10.RT.1 Cite specific textual evidence to support analysis of technical texts, attending to the precise details of explanations or descriptions.

9-10.RT.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

9-10.RT.3 Follow precisely a complex multistep procedure when performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure

9-10.RT.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 9-10 texts and topics*.

9-10.RT.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

9-10.RT.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Idea

9-10.RT.7 Translate technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

9-10.RT.8 Assess the extent to which the reasoning and evidence in a text support the author's

claim or a recommendation for solving a technical problem.

9-10.RT.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Range of Reading and Level of Text Complexity

9-10.RT.10 By the end of grade 10, read and comprehend technical texts in the grades 9-10 text complexity band independently and proficiently

Writing Standards for Literacy in Technical Subjects 9-10

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Text Types and Purposes

9-10.WT.1 Write arguments focused on *discipline-specific content*.

9-10.WT.2 Write informative/explanatory texts, including technical processes.

9-10.WT.3 Students will not write narratives in technical subjects. *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In technical, students must be able to write precise enough descriptions of the step-by-step procedures they use in their technical work that others can replicate them and (possibly) reach the same results.*

Production and Distribution of Writing

9-10.WT.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

9-10.WT.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

9-10.WT.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

9-10.WT.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

9-10.WT.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectivity to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation

9-10.WT.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

9-10.WT.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific

tasks, purposes, and audiences.

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